

WHAT IS CLAIMED IS:

1. A semiconductor device with an insulating layer including deuterium comprising:
 - a semiconductor substrate;
 - a gate insulating film including deuterium therein and formed on the
 - 5 semiconductor substrate;
 - diffusion layers formed in the semiconductor substrate and located apart from each other to be adjacent to the gate insulating film;
 - a gate electrode formed on the gate insulating film;
 - a first insulating film including deuterium therein and formed on a side surface
 - 10 of the gate electrode; and
 - a protective layer formed so as to cover the first insulating film.
2. The semiconductor device with an insulating layer including deuterium according to claim 1, the protective layer is formed so as to cover the first insulating film and the
- 15 gate insulating film.
3. The semiconductor device with an insulating layer including deuterium according to claim 1, further comprising:
 - a second insulating film including deuterium therein and formed on an inner
 - 20 surface of a trench which is formed in the semiconductor substrate; and
 - an element isolation insulating layer formed in the trench and on the second insulating layer.
4. The semiconductor device with an insulating layer including deuterium according to
- 25 claim 1, further comprising a capacitor electrically connected to one of the diffusion layers.
5. The semiconductor device with an insulating layer including deuterium according to claim 1, the protective layer is one of an insulating layer including nitrogen and an
- 30 oxide aluminum layer.
6. The semiconductor device with an insulating layer including deuterium according to claim 1, a third insulating film is formed on the gate electrode.
- 35 7. The semiconductor device with an insulating layer including deuterium according to claim 1, further comprising a side wall insulating film formed around the side surface of

the gate electrode.

8. The semiconductor device with an insulating layer including deuterium according to claim 1, the first insulating film extends on the one of the diffusion layers.

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9. A semiconductor device with an insulating layer including deuterium comprising:

a semiconductor substrate;

a gate insulating film including deuterium therein and formed on the semiconductor substrate;

10 diffusion layers formed in the semiconductor substrate and located apart from each other to be adjacent to the gate insulating film;

a gate electrode formed on the gate insulating film;

a protective layer formed so as to cover the gate insulating film and the gate electrode.

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10. The semiconductor device with an insulating layer including deuterium according to claim 8, further comprising; a first insulating film including deuterium therein and formed on a side surface of the gate electrode.

20 11. The semiconductor device with an insulating layer including deuterium according to claim 10, the protective layer is formed so as to cover the first insulating film and the gate insulating film.

25 12. The semiconductor device with an insulating layer including deuterium according to claim 8, further comprising:

a second insulating film including deuterium therein and formed on an inner surface of a trench which is formed in the semiconductor substrate; and

an element isolation insulating layer formed in the trench and on the second insulating layer.

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13. The semiconductor device with an insulating layer including deuterium according to claim 8, further comprising a capacitor electrically connected to one of the diffusion layers.

35 14. The semiconductor device with an insulating layer including deuterium according to claim 8, the protective layer is one of an insulating layer including nitrogen and an

oxide aluminum layer.

15. The semiconductor device with an insulating layer including deuterium according to claim 8, a third insulating film is formed on the gate electrode.

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16. The semiconductor device with an insulating layer including deuterium according to claim 8, further comprising a side wall insulating film formed around the side surface of the gate electrode.

10 17. The semiconductor device with an insulating layer including deuterium according to claim 8, the first insulating film extends on the one of the diffusion layers.

18. A method for manufacturing a semiconductor device with an insulating layer including deuterium, comprising:

15 forming a gate insulating film including deuterium therein on a semiconductor substrate;

forming a gate electrode on the gate insulating film;

forming a first insulating film which includes deuterium therein on a side surface of the gate electrode;

20 forming diffusion layers in the semiconductor substrate to be adjacent to the gate insulating film; and

forming a protective layer above the gate insulating film and the first insulating film.

25 19. The method for manufacturing a semiconductor device with an insulating layer including deuterium according to claim 18, further comprising:

forming a second insulating film including deuterium therein on an inner surface of a trench which is formed in the semiconductor substrate; and

30 forming an element isolation insulating layer in the trench and on the second insulating layer.

20. The method for manufacturing a semiconductor device with an insulating layer including deuterium according to claim 18, further comprising: further comprising: forming a capacitor electrically connected to one of the diffusion layers.

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21. The method for manufacturing a semiconductor device with an insulating layer

including deuterium according to claim 18, further comprising: forming a third insulating film on the gate electrode.

5 22. The method for manufacturing a semiconductor device with an insulating layer including deuterium according to claim 18, further comprising: forming a side wall insulating film around the side surface of the gate electrode.

10 23. The method for manufacturing a semiconductor device with an insulating layer including deuterium according to claim 18, the first insulating film extends on the one of the diffusion layers.

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